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A BIOLOGICAL EVALUATION OF CRAB FLATS CAMPGROUND, SAN BERNARDINO NATIONAL FOREST

John Kliejunas, Plant Pathologist
Dave Schultz, Entomologist

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ABSTRACT

The Crab Flats Campground on the San Bernardino National Forest was evaluated to develop and suggest alternative pest suppression-prevention methods which could be programed into a silvicultural prescription for the area. The major disease problems were annosus root disease, and western dwarf mistletoe on Coulter pine. The only insect activity noted was California flatheaded borer attacks on one tree within an annosus root disease center. Management options for reducing the impact of annosus root disease and dwarf mistletoe are presented, with methods for preventing losses from pine engravers and flatheaded borers. A map indicating locations of the major pest problems in the campground was prepared.

INTRODUCTION

The Crab Flats Campground on the Arrowhead Ranger District was examined on December 17, 1981, by John Kliejunas and Dave Schultz of the Forest Pest Management Staff. The objective of the evaluation was to suggest alternative suppression-prevention methods which could be programed into the silvicultural prescription being developed for the campground.

OBSERVATIONS

Vegetative cover consists of an overstory of ponderosa and Coulter pines intermixed with black oaks. The understory consists of Coulter pines, black oaks, and live oaks. Manzanita is scattered throughout the campground. Problems noted in and around the campground follow.

USDA, FOREST SERVICE, PACIFIC SOUTHWEST REGION
State and Private Forestry, Forest Pest Management
630 Sansome Street, San Francisco, California 94111

ANNOSUS ROOT DISEASE

Annosus root disease, caused by Fomes annosus, was found at four locations (see attached campground map). Confirmation was based on the presence of F. annosus conks within pine stumps. The opening in the stand behind site 18 was a typical annosus center. Stumps from recently-cut pines were present; one recently faded overstory pine attacked by the California flatheaded borer (Melanophila californicia) and one recently dead pine sapling with annosus conks were at the edge of the opening. A second annosus center behind sites 15 and 17 had five stumps with conks of F. annosus and one recently dead pine sapling at the margin.

WESTERN DWARF MISTLETOE

Western dwarf mistletoe (Arceuthobium campylopodum) was present on Coulter pines in three discrete foci in the campground area. In most cases, levels of infection were light to moderate. The pocket of dwarf mistletoe infestation at and behind site 14 had one heavily-broomed overstory pine which was the source of infection for sapling and pole-sized pines in the vicinity.

OTHER PROBLEMS

The only insect activity noted was the California flatheaded borer attacks on the annosus-infected tree behind site 18.

In addition to annosus root disease and dwarf mistletoe, two diseases of currently minor significance were noted. Armillaria root rot, caused by Armillariella mellea, was associated with two pine stumps at site 2 and with three pine stumps in the opening behind sites 4 and 29. Armillariella mellea is, in most cases, considered to be a secondary invader of conifers in California and is commonly associated with dying and dead trees. True mistletoe (Phoradendron villosum subsp. villosum) was present at low levels on black oaks and live oaks throughout the campground. Control of true mistletoe is generally not warranted, but pruning of infected branches flush with the main bole will reduce the amount of seeds available for further buildup and may increase the vigor of affected trees.

Signs of pocket gopher activity were common throughout the campground and were most abundant in the vicinity of sites 19-21, where winter casts were present.

Oaks at sites 4 and 23 had dead limbs, which present a hazard, hanging over or near the picnic tables.

An aggregation of Coulter pine saplings and poles between site 15 and the restroom was densely stocked, with a basal area of 220 square feet/acre. A second dense aggregation was present at the margin of the annosus center behind sites 2 and 3.

BIOLOGY OF PEST ORGANISMS

ANNOSUS ROOT DISEASE

Fomes annosus is a fungus that attacks a wide range of woody plants, causing decay of the roots and butt and the death of sapwood and cambium. All conifer species in California are susceptible to the fungus. Hardwood species are rarely damaged or killed. Madrone (Arbutus menziesii), and a few brush species (Arctostaphylos spp. and Artemisia tridentata) are occasional hosts.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or in the duff at the root collar. The fungus becomes established in freshly cut stumps from airborne spores produced by the conks, and then grows into the root system. The fungus subsequently spreads to healthy roots of surrounding susceptible species via root contacts. Local spread of the disease outward from an infected stump typically results in the formation of a disease center, with stumps and older dead trees near the center and fading trees on the margin. The centers continue to enlarge until they reach barriers, such as openings in the stand or groups of nonsusceptible plants.

The fungus may remain alive for as long as 50 years as a saprophyte in infected roots and stumps. Young susceptible trees invading the site often become infected and die after their roots contact old infected root systems in the soil.

WESTERN DWARF MISTLETOE

Western dwarf mistletoe (Arceuthobium campylopodum) infects Jeffrey, ponderosa, knobcone, and Coulter pines. Other conifers or hardwoods are not infected by this particular species. Dwarf mistletoes are obligate parasites that are completely dependent on their host for support, for water, and most of their mineral and organic nutrients. They often cause the formation of "witches' brooms", or dense masses of distorted branches on the host, that divert nutrients from the rest of the tree. Infection can cause growth reduction, abnormalities, mortality and predisposition to attack by other pests. In particular, infected trees appear to be more susceptible to attack by bark beetles and the California flatheaded borer than do uninfected trees. The dwarf mistletoe/bark beetle complex is responsible for 40 to 60% of the pine mortality in southern California during years of normal precipitation. Mortality is more frequent when other stress factors occur, such as drought, oxidant air pollution damage, or competition in overstocked stands.

Dwarf mistletoe spreads between trees and within crowns of trees by means of small seeds that are forcibly ejected into the air. Spread from overstory to understory is limited to the distance the seeds are shot, generally 20 to 60 feet, but as much as 100 feet if assisted by wind or on steep slopes. Horizontal spread in an even-aged pine stand averages one to two feet per year with a vertical spread rate up the crown at about four inches per year.

PINE ENGRAVER BEETLE

There was no pine engraver activity within the Crab Flats Campground but pines with recent top kills were seen nearby. Any work done in the campground that creates fresh pine slash could have an effect on local pine engraver populations.

Pine engravers (Ips spp.) will breed either in the tops of live pine trees or in fresh green slash. Attacks on live trees are usually limited to trees which are suppresssed, or stressed by dwarf mistletoe, root disease, drought, fire, or the attack of other insects. If fresh slash is available in the spring, the pine engravers may build up in an area and cause locally heavy top killing by mid-summer. Attacks are made with the coming of warm weather in the spring. A new generation is produced in 6-8 weeks in the spring, to 4-6 weeks in mid-summer (August). Thus, several overlapping generations per year may be produced. The winter may be passed in any of the life stages of larvae, pupae, or adults, depending upon species involved.

Outbreaks in standing, healthy trees are sporadic and of short duration, and are often associated with some temporary stress or shock afflicting the host species, such as severe competition or sudden opening of the stand. Tree killing frequently occurs where green pine slash, which serves as breeding habitat, is left untreated during spring and summer.

Fresh pine slash caused by thinning, dwarf mistletoe control work, construction or winter storm breakage can be modified in a number of ways to make it unsuitable for pine engraver breeding. One approach to minimizing damage is to schedule slash-generating activities mostly in the late summer, fall and early winter, when the beetles are not flying or the slash has a high probability of drying out before the beetles can complete their development. Green pine slash created during the spring and summer should be treated to prevent the buildup of pine engraver populations. Because pine engravers can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective. Some methods of slash treatment that might be acceptable in dispersed recreation areas would include lopping and scattering slash in sunny areas to speed its drying out, crushing or mashing slash with logging equipment to make it unsuitable for pine engraver breeding, or piling and burning the slash within a month of cutting. Broadcast burning the slash might work if it could be done while the slash was green without damaging the residual stand. Another method which might work is to pile slash in a sunny area and tightly cover the pile with clear plastic. If the temperature under the bark of slash in all parts of the pile reaches 120^{o}F, all brood currently in the pile will be killed. Lower temperatures will not be effective and, where successful, this method will not prevent reinfestation of slash piles. The most acceptable methods of slash treatment in high-use recreation areas would probably be disposal by chipping or removal from the site.

CALIFORNIA FLATHEADED BORER

The California flatheaded borer (Melanophila californica) principally attacks Jeffrey and ponderosa pines, although it may be found in other pines.

It is most severe in stands located on sites where environmental stress is common. Decadent or unhealthy trees are most frequently attacked, along with an occasional top of a thrifty, vigorous tree.

Eggs are laid in bark crevices of the host tree. Newly hatched larvae penetrate directly through the bark to the phloem. Here the larvae may feed from a few months to 4 years without any apparent effect on the host tree. Should host vigor and larval abundance not allow them to succeed, the larvae cut very short galleries before they die. These galleries do not seriously injure the tree and are overgrown by the cambium. Should conditions be, or become, favorable for the larvae and unfavorable for the tree, the larvae develop rapidly and destroy the cambium.

Although this insect can kill trees weakened by dwarf mistletoe and root disease, its primary importance is rendering trees increasingly susceptible to bark beetles.

MANAGEMENT OPTIONS

1. No change in present management. Fomes annosus will persist in the infected stumps and roots until the wood has been completely rotted. Conifers on the edge of active annosus centers will become infected and will probably die after being attacked by bark beetles or flatheaded borers. Conifers in the annosus root disease centers will become infected and die as their roots reach old infected roots and stumps, and the fungus will be perpetuated in the area.

Dwarf mistletoe will increase in intensity in Coulter pines already infected and will spread to surrounding susceptible Coulter and ponderosa pines. Severely infected trees have a high probability of dying in 10 to 15 years.

Tree aggregations with high basal areas have a high probability of being attacked by bark beetles or engraver beetles during periods of low precipitation. Rodent activity will prevent successful establishment of vegetation in open areas.

2. Reduce impact of Fomes annosus. Once annosus root disease is established in a stand, no direct control is available. Control, therefore, involves prevention of new centers by decreasing the risk of stumps infection and silvicultural manipulations of infected stands to minimize the effects of the disease. The following alternatives are available:

a. Prevent stump infections. Application of granular borax to freshly cut coniferous stumps is effective in preventing most (90%) new infections. The chemical is toxic to the spores of F. annosus, but has no effect on existing infections. Borax application is required on all coniferous stumps cut in and near developed recreation sites (FSM R-5 Supp. 2305 and

2331.5). Application requires the submission of a Pesticide Use Proposal. Review and approval of the Pesticide Use Proposal by the Chairman, Integrated Pest Management Work Group, is necessary before the borax can be applied.

b. Plant hardwoods. Revegetation of active annosus centers should be done only with resistant species. All conifers are susceptible to the fungus. Leaving the centers barren or planting them with resistant hardwoods will result in the fungus eventually dying out so that conifers can again re-established. Unfortunately, this will likely take 50 or more years.

Favoring the oaks already present and planting other suitable hardwood trees or shrubs will provide shade as well as establish a barrier of non-susceptible roots that may limit the spread of the annosus centers.

c. Thinning. Thinning of dense stands of Coulter pine, such as at the margin of the annosus center behind sites 2 and 3, will minimize opportunities for root contact and subsequent spread. Sparse stands or stands of mixed susceptible and resistant trees will be less subject to damage. Thinning will also increase tree vigor and thus reduce the risk of damaging activity by bark beetles. Stumps created during thinning must be treated with borax and slash created should be treated - such as by chipping, burning, or removing from the site - to minimize pine engraver buildups.

3. Reduce impact of dwarf mistletoe. Several alternatives for reducing the impact of dwarf mistletoe in recreation sites are available. FPM funding may be available for approved dwarf mistletoe control projects. It should be kept in mind that even if efforts to control dwarf mistletoe are successful, the trees will likely die from root disease and subsequent beetle attack if they are within active annosus centers.

a. Pruning of infected branches. Removing heavily-broomed branches is effective in increasing tree vigor of high value trees in recreation areas. The objective of broom pruning is to increase a tree's vigor, and thereby to prolong its life, by removing a source of nutrient and moisture drain. High-value trees can be pruned of brooms in the lower crown if after removal of the brooms, the tree will still have a live-crown ratio of 30% or more. When pruning, all branches should be cut flush with the bole.

Pruning of all infected branches in infected trees in an attempt to eradicate the dwarf mistletoe is generally not recommended. But in exceptional cases, where attempted on high value-trees, this treatment should be restricted to trees with a Hawksworth 6-class dwarf mistletoe rating of 1 or 2 which have infections restricted to the lower 1/3 of the crown. When pruning, all branches in the lower 1/2 of the crown should be removed. This treatment should not be attempted if it will result in a tree with a live crown ratio of less than 30%, or if the tree will be exposed to continued infection from adjacent infected trees. The trees should be re-examined every 2 years for a 6 year-period and re-treated by removing previously undetected infections.

Green pine slash caused by broom or branch pruning should be treated so as to reduce the risk of pine engraver (Ips spp.) buildup. Slash created in the spring or early summer should be lopped and scattered, piled and burned while green, chipped, or removed from the site.

b. Remove infected overstory trees to protect regeneration. If the objective is to save understory trees, the infected overstory trees should be removed to eliminate the source of inoculum. The understory should then be thinned and pruned to eliminate dwarf mistletoe infections. Some areas of the campground may be planted with susceptible conifers if removal of the infected overstory eliminates a source of infection.

c. Thinning. Thinning of infected stands will aid in maintaining optimum growth of residuals and reduce stress. Following release, lightly infected residuals may vertically outgrow the dwarf mistletoe. Uninfected trees should be favored as leave trees. The removal of all trees with 6-class dwarf mistletoe ratings of 5 and 6 should be considered, because these trees have a high probability of dying in the next 10 to 15 years. Treat all freshly cut stumps with borax to prevent invasion by F. annosus.

d. Create buffer strips. The creation of buffer strips (areas free of susceptible hosts) should be considered at the margins of dwarf mistletoe infestations to prevent spread into or out of the treated area. Natural buffers such as roads or stand openings will serve this purpose, or susceptible species can be removed and the strip planted with nonsusceptible species. At Crab Flats, sugar pine may be an acceptable choice for planting. Sugar pine is not susceptible to the species of dwarf mistletoe now present in the campground, the few sugar pines occurring naturally in the understory appear vigorous and suited to the site, and although sugar pine dwarf mistletoe (A. californicum) occurs a few miles away, it is not now present in the campground.

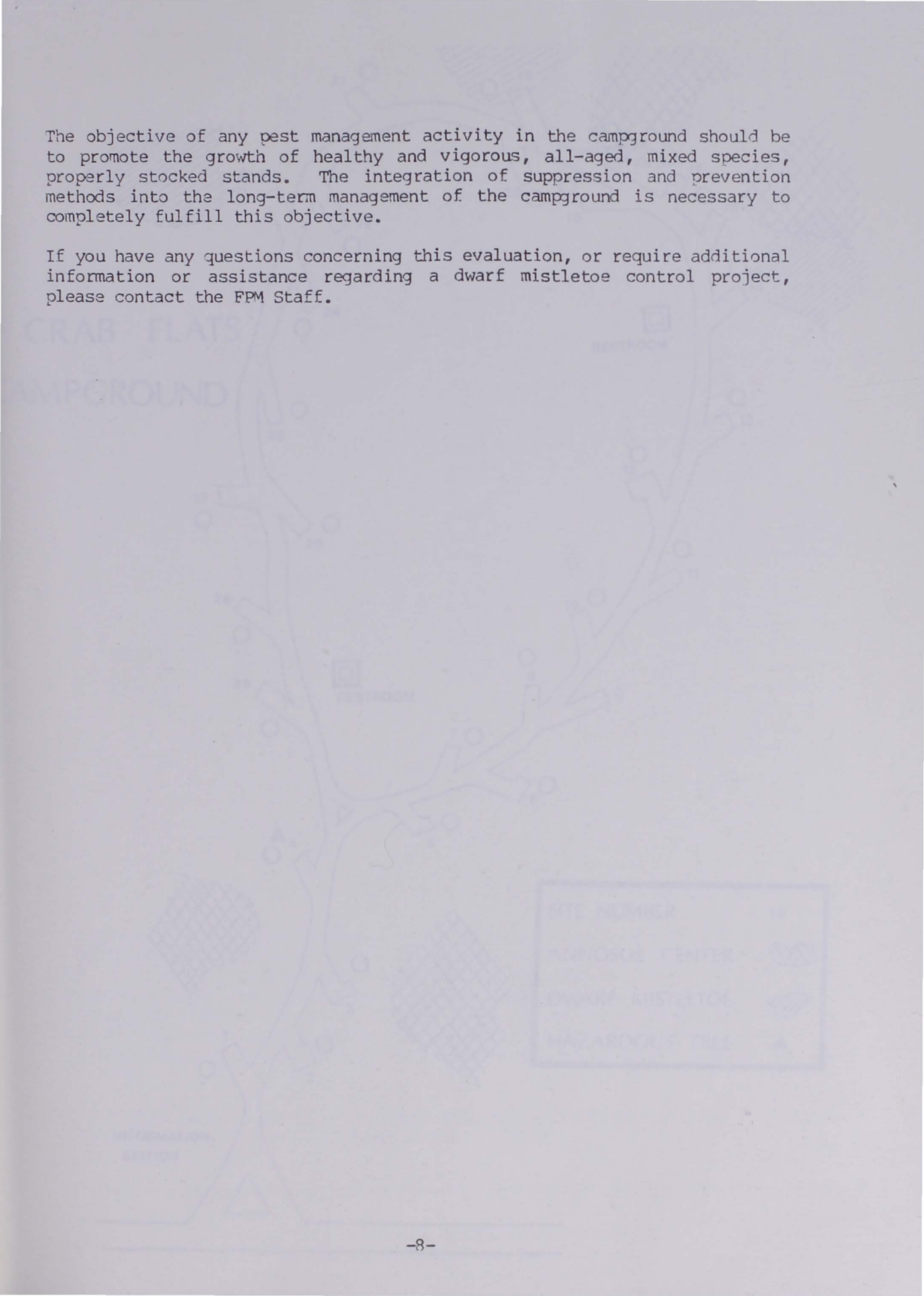
3. Thin areas with high basal areas. Reducing the residual basal area to 120-150 square feet in the dense Coulter pine aggregations will aid in the control of several present and potential pest problems in the campground. Thinning dense stands of conifers will minimize opportunities for root contact and subsequent spread of F. annosus. Thinning of stands which are infected with dwarf mistletoe will remove an additional stress on the trees and increase their lifespan. In areas which are currently free from diseases, the major effect of reducing the basal area would be to increase tree vigor and thus reduce the risk of attack by bark beetles or engraver beetles. Stumps created during thinning must be treated with borax, and slash should be treated to minimize buildup of pine engraver beetles.

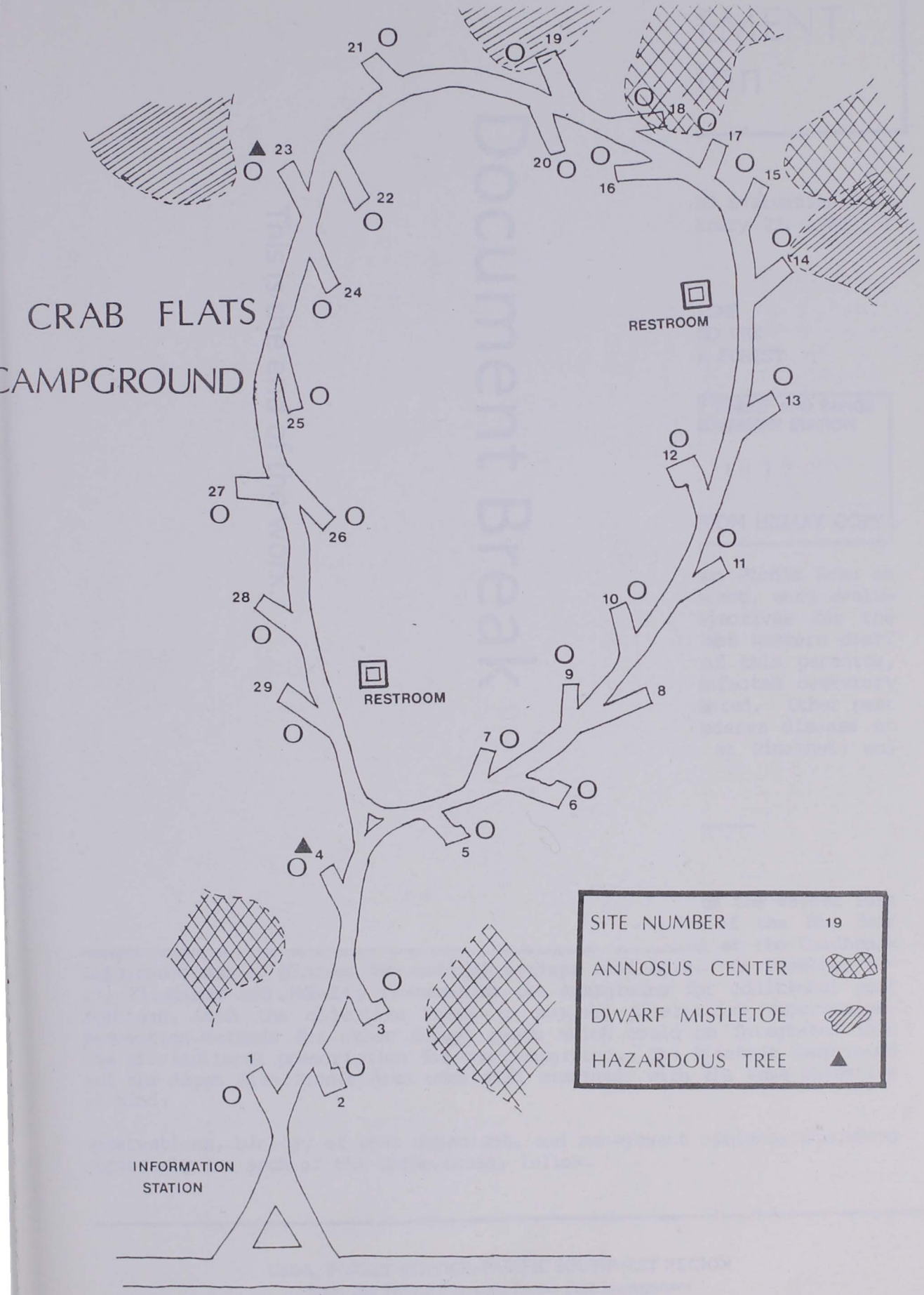
4. Control rodents. The open areas of the campground show evidence of a high gopher or other burrowing rodent population. Without rodent control, planting those areas will likely be unsuccessful.

5. Integrate treatments. Management alternatives 2, 3 and 4 are not mutually exclusive; they can be used alone or in combination in various parts of the campground to produce the desired results. Consideration of the interactions among all pest problems present will result in a successful integration of pest management strategies.

The objective of any pest management activity in the campground should be to promote the growth of healthy and vigorous, all-aged, mixed species, properly stocked stands. The integration of suppression and prevention methods into the long-term management of the campground is necessary to completely fulfill this objective.

If you have any questions concerning this evaluation, or require additional information or assistance regarding a dwarf mistletoe control project, please contact the FPM Staff.




CRAB FLATS
CAMPGROUND
RESTROOM
RESTROOM
INFORMATION
STATION
SITE NUMBER 19
ANNOSUS CENTER
DWARF MISTLETOE
HAZARDOUS TREE